



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## TRANSMISSION OF SPOTTED FEVER BY OTHER THAN MONTANA AND IDAHO TICKS.\*†

MARIA B. MAVER.

(From the Pathological Laboratory of the University of Chicago.)

Experiments having shown that the mild Idaho type of spotted fever may be transmitted by *D. venustus* of Montana and that the more virulent northern type of fever may be carried by *D. modestus* of Idaho, it became a matter of interest to determine whether ticks of other species, indigenous in widely separated areas, might also be capable of acting as agents of transfer of the spotted fever virus. In order to carry out experiments on this point arrangements were made with several entomologists for supplies of wood ticks from their localities. Ticks were received from Maine, California, Texas, Utah, and Missouri. The study of these ticks as intermediate hosts for the parasite of spotted fever was taken up according to the same plan as that used in studying the transmission of the virus by the Idaho and Montana ticks.

Two strains of the diseases were maintained in guinea-pigs at the Chicago laboratory at this time—the “Bradley” strain, which had arrived at the 179th consecutive passage from the human virus, and a so-called “natural tick strain,” also in guinea-pigs in its 8th passage, produced by the bite of *D. venustus* (Montana) from nature. Both strains were used in these experiments.

1. *Transmission by Dermacentor variabilis* (Say).—Specimens of this tick have been found from Labrador to Florida. West of the Mississippi it is not common. It has been found on a great variety of small animals, more frequently on cattle and dogs, and, occasionally, on man.

During the month of July, 1909, two collections of this species were received from Dr. Ricketts, having been collected by him in the vicinity of Woods Hole, Mass. Fifty adult ticks, the females in various stages of engorgement, comprised these groups.

\* Received for publication January 5, 1911.

† This work was supported by a grant from the Memorial Institute for Infectious Diseases, Chicago.

Guinea-pig 2,266, 4th passage "natural tick strain," after an incubation period of four days, was placed in the stock, with a temperature of 104° F. On the fifth day after inoculation, one male—No. 1—and one female—No. 5—tick were attached to this guinea-pig for 48 hours during the period of fever. This animal died on the eighth day of the disease, the autopsy showing specific spotted fever lesions with the hemorrhagic vulva. The impregnated female tick became much enlarged and dropped off semi-mature after two days' feeding. Any further test of this tick was impossible owing to the fact that semi-mature females rarely become reattached. The female was placed in a pill box for oviposition and a later test of her larvae for inherited infection was made.

The male tick which had fed on guinea-pig 2,266 was placed on normal guinea-pig 2,284 and remained attached for 72 hours; the temperature of this guinea-pig remained normal during a period of 18 days following attachment. The tick was found off in the sack, reattached, and removed four days later, in all a period of seven days' attachment. An immunity test given this pig with 1 c.c. of "Bradley" virus developed a characteristic case of the disease. This male tick did not transmit the disease.

Guinea-pig 1,840 of the 197th "Bradley" strain passage was taken on the third day of fever with a temperature of 105.6° F. Two female ticks—Nos. 8 and 9—attached themselves behind the ears of the pig after a short period. This guinea-pig died four days later with the engorged ticks still attached.

The female tick 8 was immediately transferred to normal guinea-pig 2,321, and remained in the same location on this pig for six days. No disease developed in this guinea-pig, and on being given 1 c.c. of "Bradley" virus it died of spotted fever in eight days. For further maturation and impregnation of female No. 8, male No. 1 of this group was placed with her. Oviposition began eight days later. Examinations of the stained specimens of these fresh eggs were made for bacilli, but no organisms were found. Examinations of eggs from normally developed ticks were also negative. Fifty fresh eggs from female No. 8 were crushed in physiological salt solution, and injected into a guinea-pig intraperitoneally, but with no production of symptoms. About 600 larvae were hatched

from the eggs. These larvae matured on a normal guinea-pig without infecting it, 26 enlarged larvae being collected from this pig. After their normal period of moulting, the nymphs were again tested on a normal pig. In no period of their development did they transfer the disease. Seven of the eleven females matured and deposited eggs, hatching large numbers of larvae.

From female 5 about 300 larvae were placed with infected guinea-pig 2,375 of the 189th "Bradley" passage; 35 larvae fed on this pig. Five infected guinea-pigs were placed in this sack and died of the disease during the feeding of these larvae. Fourteen nymphs and 19 enlarged larvae were collected. Normal guinea-pig 2,536 was infected by this batch of nymphs. The temperature of the pig ran 103°, 105.6°, 105.6°, 104.5°, and it died on the fifth day. On the third day 3 c.c. of its blood was withdrawn and inoculated into a normal and an immune guinea-pig of the natural tick strain. The immune pig did not respond to the virus. The normal died on the sixth day of fever with specific spotted fever lesions. Again blood was transferred from this guinea-pig to immune and normal pigs with the same result; the normal guinea-pig died on the eighth day, the immune showed no indication of disease.

The larvae from five females were associated with infected guinea-pigs 2,371, 2,436, and 2,482 and 2,311 of the "Bradley" strain. These pigs died of the disease, one after the other, while the larvae were feeding. A second test of these nymphs was made on normal guinea-pig 2,563. Two of the above larvae fed on this pig. On the seventh day after attachment a fever temperature began. The pig died on the eighth day. Two passages of blood were made to normal pigs and to immune pigs. The normal pigs developed spotted fever; the immune pigs were unaffected.

Two adults ticks from this group produced infection in normal guinea-pig 2,873. This pig died on the eighth day after tick attachment; transfer of blood to normal pig 2,915 produced a less severe course of fever, which conferred immunity to the "Bradley" virus.

2. *Dermacentor marginatus Utah* (Banks).—Note received with these specimens: Dallas, Sub. acc. No. 654, seed ticks hatched from eggs deposited August 14, and days following. Hatching began

September 3, adult females taken from jack rabbit, August 9, 1909, at Milford, Utah, by W. V. King.

The larvae were placed with normal and infected guinea-pigs in equal numbers. Eight nymphs matured on the normal animal. As a routine this pig was given an immunity test with "Bradley" blood. This resulted in the usual course of fever. Five infected guinea pigs were used to mature and infect the other half of these larvae. After a period of moulting four of these nymphs were allowed to feed on normal guinea-pig 2,567. On the seventh day after attachment a fever began, resulting in death on the fifth day. Passage of the heart's blood of this pig into an immune and a normal pig gave no results in the immune animal but produced typical spotted fever in the normal. A second passage was made with the same result.

3. *Amblyomma Americanum* Linnaeus.—This species is commonly known as the "lone star tick" because of the single yellow spot on the shield of the female. These specimens were received from Missouri in all stages of adult engorgement. The many attempts made to attach these ticks to guinea-pigs were unsuccessful. Nine of the number were selected for oviposition, which was evidently premature in every case. The ticks were small and comparatively few eggs were deposited. Hatching took place from the eggs of females 1, 2, 8, and 9, with about 1,200 larvae in all. Two groups were made of these larvae, about 600 in each, and placed with normal and infected guinea-pigs.

From two pigs, 2,410, 2,426, infected with the "natural tick strain" 100 larvae fed and were collected later from the débris in the sack. These enlarged larvae developed in two weeks into nymphs, passing through a moulting stage. These nymphs were associated with normal guinea-pig 2,544 for a period of two weeks and eleven attachments noted before fever temperature with the characteristic hemorrhagic scrotum developed. The pig was bled from the heart and died on the fifth day. Two passages of blood from this infected pig to normal and immune pigs were made, both resulting as before in infection of the normals and no disease in the immunes. From the 14 infected nymphs, four females and two males were attached to normal guinea-pig 2,874. Three days

later the disease was indicated in this pig by a temperature of  $104^{\circ}$ , reaching  $106.8^{\circ}$ , and the development of hemorrhagic genitalia. Death resulted after a slight decline in temperature on 13th day. The ticks were removed after the death of the pig and immediately transferred to another pig. This pig died on the tenth day, after a severe run of fever, with necrosis of the ears and scrotum. The autopsy in each case showed typical spotted fever lesions.

4 and 5.—A large number of the larvae of the species *D. albipictus* were dead when they reached the laboratory. About 50 of the living ones were placed with infected guinea-pig 2,391. Only one of these was found mature and died before further test could be made. The larvae of the *D. variabilis* (Utah) were in poor condition when received. An effort made to keep them alive on a normal pig failed.

6. *Ornithodoros megnini* Duges (California) was a very interesting specimen. Much time was given to the work of attaching these ticks to rabbits, without success. After a latent period of five months, oviposition took place, and a great number of larvae hatched out. When placed with an infected guinea-pig they immediately filled the ears and hung in bunches about the face of the pig. The pig died in this condition. The ears were cut off in the hope that these larvae would detach themselves later. This did not prove the case, and the whole mass died attached.

#### SUMMARY.

Ticks from six different localities were received, and of these three groups developed so that complete tests could be made, and by means of each of these three, spotted fever was transmitted from infected to normal guinea-pigs. In the case of *Dermacentor marginatus* (Utah) and *Amblyomma Americanum* Linnaeus (Missouri) the transfer was made with nymphs; no adult ticks were tested. In the case of *Dermacentor variabilis* (Mass.) transmission of the virus was effected by nymphs and later by adult ticks.

From these experiments it appears that in so far as ability of ticks from various regions to transmit the virus of spotted fever is concerned, the disease might find favorable conditions for its existence in localities other than those to which it now is limited.